

3. Compatibility of Sodium Bicarbonate with other Pesticides.

The issue of compatibility of SBC with other pesticides is of major concern. As SBC controls only powdery mildew disease the grower would expect to be able to add other fungicides [or an insecticide] to the tank at spraying. If such mixtures were not possible, then the resulting double spraying operations, could prove the use of SBC uneconomic or impractical.

The recommended concentration of SBC for spray application is 0.5% but the pH of such a solution is around 8.4 (i.e. highly alkaline). High pH is a significant concern as it can cause some pesticide materials to undergo a chemical breakdown or degradation called "alkaline hydrolysis". Hydrolysis can be explained by, hydro meaning water, and lysis meaning split. Alkaline water (high pH) occurs when the hydroxyl ions in water outnumber the hydrogen ions. When sensitive pesticides are dissolved in alkaline water, bonds are broken in their molecular structure. Hence alkaline water increases the decomposition rate of the pesticide, often providing a much poorer pesticide performance than would otherwise be expected.

The severity of losses due to alkaline hydrolysis is governed by the following factors:

- 1) The degree of water alkalinity;
- 2) The susceptibility of the pesticide to alkalinity;
- 3) The amount of time the pesticide is in contact with the water;
- 4) The temperature of the spray solution.

As many pesticides are susceptible to alkaline hydrolysis, most pesticide manufacturers provide information on the rate at which their products will break down under alkaline conditions. This information is usually expressed as a product's "half-life", or the length of time taken for the original strength to be reduced by half. Table 5 summarizes such information for pesticides which have a label claim for use in grapes, (Custom Chemicides).

Table 5: Rate of hydrolysis of pesticides registered for use in viticulture.

Common/Trade Name	Chemical/Technical Name	Comments - Rate of Hydrolysis Time for 50% Decomposition
Bayleton	Triadimefon	Stable at pH of 4 to 5.
Benlate	Benomyl	pH 7 = 12 minutes, pH 6 = 6.8 hrs., pH 5.6 over 30 hrs.
Bravo	Chlorothalonil	pH 7 = 12 minutes, pH 6 = 6.8 hrs.

Common/Trade Name	Chemical/Technical Name	Comments - Rate of Hydrolysis Time for 50% Decomposition
Captan or Captor	Captan	pH 10 = 12 minutes, pH 4 = 4 hrs.
Diazinon	Diazinon	pH 9 = 136 days, pH 7.5 = 185 days, pH 5 = 31 days. More stable at neutral.
Dipel	<i>Bacillus thuringiensis</i>	pH 5 to 7 optimal range for effectiveness, unstable in pH above 8.
Imidan	Phosmet	pH 8.3 = 4 hrs., pH 7 = 12 hrs, pH 4.5 = 13 days.
Kelthane	Dicofol	Stable at pH of 5.5 to 6.0, pH 7 = 15 minutes.
Lannate	Methomyl	pH 9.1 = loss of 5% in 6 hrs. Stable only in slightly acid water 6.0.
Lorsban	Chloropyrifos	pH 10 = 7 days. Stable in neutral & weekly acidic solutions.
Mancozeb	Dithane	Stable in neutral or acid solutions
Maldison	Malathion	Hydrolysis is rapid at a pH just above 7.0.
Mavrik	Fluvalinate	Do not mix with strongly basic products.
Saprol	Triforine	Stable to pH 10 or 11.
Systhane	Myclobutanil	Not affected.
Rovral	Iprodione	pH 8 or higher causes rapid hydrolysis. pH 7 optimal effectiveness.
Ripcord	Cypermethrin	pH 9 = 35 hrs., more stable in acid solutions.
Rubigan	Fenarimol	Not effected by pH.

The alkaline hydrolysis rates listed in Table 5 indicate that combining SBC with some of the pesticides listed would result in unacceptable decomposition and this would adversely effect their performance. This group includes; Bravo, Dipel [*Bacillus thuringiensis*], Kelthane, Maldison, Mavrik and Rovral.

Benlate is an exception, as the alkaline hydrolysis rates in Table 5 do not indicate its true fungicidal life. Even though Benlate has rapid decomposition in neutral or alkaline solutions, this is of no concern, as the metabolite, carbendazim, is the active form of this fungicide (Slade, 1978).

Some of the other pesticides ie, Captan, Imidan, Lannate, and Mancozeb, appear to be intermediate in susceptibility to alkaline hydrolysis. Pesticide hydrolysis starts from the time of mixing, through storage in the tank, and continues until the water has evaporated from the spray droplet lying on the leaf. Hence it is still possible to combine these pesticides with SBC if the time interval between mixing the pesticide and its drying on the leaf is minimized. Thus it would be important not to let a spray rig stand for any extended period of time before spraying out any of these pesticides.

The group of pesticides that show good tolerance to alkaline hydrolysis, includes Saprol, Systhane, Rubigan [all demethylation inhibitor (DMI) fungicides] and the insecticides Lorsban and Diazinon.

The principle cause of breakdown of pesticides on foliage is through photodecomposition from sunlight, rather than from hydrolysis. Thus, cool cloudy weather, during and after application, will enhance the persistence of residues whether or not the spray deposit contains SBC.

Alkaline hydrolysis rates for Euparen, Shirlan, Polyram, Ronilan, Thiram and copper based fungicides were not available. As the product labels for; Euparen, Shirlan, and Ronilan state - 'do not mix with alkaline materials', we can assume that these fungicides should **not** be applied in combination with SBC. Unfortunately, SBC does not control botrytis bunch rot and appears to be incompatible with the major botryticides [Euparen, Shirlan, and Ronilan] currently used in viticulture. The following are a range of approaches that could resolve this issue:

1. In the future growers may be to use SBC in conjunction with JMS Stylet oil or a novel soft soap, both of which have claimed botryticide activity (Simons *et. al.*, 1995). The activity of these products is being further tested in Hawke's Bay this season by HortResearch.
2. SBC appears to be compatible with the botryticide, Benlate. However Benlate has limited use in botrytis control due to the development of strains of *Botrytis* resistant to the fungicide .
3. Otherwise, simply apply SBC as separate spray when the standard botryticides are applied.

It is expected, but not confirmed, that SBC would be compatible with copper based fungicides, as they are also alkaline. Although SBC does not control downy mildew, phomopsis or black spot, it appears to be compatible with mancozeb and the copper fungicides used in their control

In conclusion, information to date indicates that SBC would be compatible with the insecticides Lorsban and Diazinon, and several of the DMI fungicides [which are often used to control powdery mildew when disease pressures are high.

Further work is required to confirm SBC compatibility and to fill in the gaps of knowledge regarding alkaline hydrolysis rates. We are expecting this be the undertaken by a chemical company interested in producing a commercial SBC product.